

**STANDARDIZED PROCEDURE**  
**CARDIAC STRESS TESTING MYOCARDIAL PERFUSION –**  
**PHARMACOLOGICAL INFUSION WITH A2a AGONIST AGENTS:**  
**ADENOSINE, DIPYRIDAMOLE, & REGADENOSON (Adults)**

**I. DEFINITION**

This protocol covers the task of cardiac stress testing by an Advanced Health Practitioner to noninvasively evaluate for ischemia with nuclear imaging. The purpose of this standardized procedure is to allow the Advanced Health Practitioner to safely perform cardiac stress testing.

**II. BACKGROUND INFORMATION**

- A. Setting:** The setting (inpatient vs. outpatient) and population (adults) for the Advanced Health Practitioner (AHP) is determined by the approval of the privileges requested on the AHP Privilege Request Form.
- B. Supervision:** The necessity of this protocol will be determined by the Allied Health Practitioner in collaboration with the supervising physician or his/her designee. Designee is defined as another attending physician who works directly with the supervising physician and is authorized to supervise the AHP. Direct supervision will not be necessary once competency is determined, as provided for in the protocol. The AHP will notify the physician immediately upon involvement in any emergency or resuscitative events or under the following circumstances:
1. Patient decompensation or intolerance to the procedure.
  2. Outcome of the procedure other than expected.
- C. Indications:** To evaluate for coronary ischemia.
- D. Warnings and Precautions:**
1. A2a receptor agonists and Dipyridamole may depress the SA and AV nodes. Patients with profound bradycardia, high degree AV block, or sinus node dysfunction should not be given pharmacologic stress agents unless they have a functional pacemaker.
  2. A2a receptor agonists and Dipyridamole may cause bronchospasms, especially in patients with moderate to severe asthma/COPD. Do not administer to patients with uncontrolled bronchoconstrictive disease and/or active wheezing.
  3. Hypotension may occur due to arterial vasodilation. The risk of severe hypotension is higher in patients with autonomic dysfunction, stenotic valvular heart disease, pericarditis or pericardial effusion, carotid artery disease with cerebrovascular insufficiency, or pulmonary hypertension. Strokes have occurred after Regadenoson injection, potentially due to hemodynamic changes associated with hypotension or hypertension. Do not administer pharmacologic stress agents to patients with systolic blood pressure <90mmHg or >180mmHg. (Or at the discretion of the provider).

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4. Regadenoson may lower the seizure threshold, and Aminophylline may increase the risk of seizures. Anticonvulsants should be available to administer if seizures occur following Regadenoson injection.
5. Atrial arrhythmias, fatal cardiac arrest, life threatening ventricular arrhythmias, or myocardial infarction may be induced by pharmacologic stress agents. Do not stress patients with recent acute myocardial infarction, unstable angina, or uncontrolled cardiac dysrhythmias (ie: unstable ventricular ectopy/tachycardia). Resuscitation equipment and trained staff should be available before performing pharmacologic stress tests.
6. Caffeine ingestion or medications containing caffeine/Theophylline/Dipyridamole may attenuate the effects of A2a receptor agonists.
  - Hold caffeine products (including coffee, tea, colas, chocolate, cocoa) for 12 hours prior to stress testing.
  - Hold Theophylline, Persantine (Dipyridamole), and any Xanthine derivatives for 48 hours prior to stress testing.
7. Other Contraindications:
  - Known hypersensitivity to Adenosine, Dipyridamole, or Regadenoson
  - Symptomatic or decompensated heart failure
  - Acute pulmonary embolus or pulmonary infarction
  - Acute myocarditis or pericarditis
  - Left main coronary stenosis

### **III. MATERIALS**

Supplies are available in the Nuclear Medicine department or EKG Stress Lab and may include IV kits and needles/syringes, normal saline flushes, IV tubes/bags, and equipment for monitoring vital signs and ECG. Medications are available in the Pyxis. Radioactive isotopes are managed by the Nuclear Medicine staff.

### **IV. PROCEDURE**

#### **A. Pre-Test Evaluation:**

1. Identify patient with two patient identifiers. Obtain focused history and check appropriateness of the test. Assessment should include:
  - Chief complaint and HPI (onset, precipitating and alleviating factors, location, quality, quantity, frequency, duration, effects on lifestyle)
  - Past medical and surgical history (prior CAD or cardiac risk factors, coronary revascularization, asthma/COPD, cardiac surgery)
  - Social history (tobacco use or illicit drugs)
  - Family history of early heart disease or sudden death

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- Allergies (document severity and nature of allergy if known)
  - Pertinent Medications
  - Caffeine intake (no caffeine 12 hours prior to test)
  - NPO status (no food for at least 2 hours prior to test)
2. Physical Exam:
- General appearance
  - Heart sounds and any evidence of volume overload
  - Lung sounds
3. Relevant Diagnostic Studies:
- Resting Images/EF if available
  - Previous ECGs, vital signs, stress tests, echos, cath report, PFTs
  - Labs (CBC, BNP, Troponin I)
    - a. Must have 2 negative or down-trending troponins within the first 24 hours from the onset of chest pain for patients being evaluated with unstable angina/ACS.
    - b. ER or CDU patients must have at least 1 negative troponin if onset of CP is over 12 hours prior to arrival.
4. Patient education and consent:
- Explain indication and procedure with the risks including possible adverse events and side effects such as chest pain, shortness of breath, wheezing, headache, flushing, warm feeling, abdominal discomfort, dizziness or lightheadedness, nausea, or fatigue.
  - Obtain consent with patient/guardian and medical interpreter if present.

**B. Patient Preparation:**

1. Nuclear Medicine staff will insert PIV and inject radioactive isotope for resting images. After resting images are completed, patient will be brought into an exam room for the stress test. If patient is undergoing the stress portion only, then patient will be brought immediately into an exam room after the PIV is inserted.
2. Attach equipment for obtaining baseline vital signs and ECG. Monitor throughout the test.
3. Ensure that the IV is patent and the isotope and Nuclear Medicine tech is available when ready to inject the stress agent.

**C. Set-up and Procedure:**

1. Prepare the drug for infusion/injection:

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- a. Adenosine: 140 mcg/kg/min infused over 4-6 minutes. Mix the Adenosine dose in a 60 ml syringe with normal saline up to 50 ml total volume. Insert the syringe into the infusion pump and begin infusion. Inject isotope at 2-3 minutes after infusion has begun. Continue infusion 2-3 minutes after isotope has been administered.
  - b. Dipyridamole: 0.56 mg/kg/min infused over 4 minutes. Mix the dose in a 60 ml syringe with normal saline up to 48 ml total volume. Insert the syringe into the infusion pump and begin infusion. Inject isotope 2-3 minutes after the infusion is complete.
  - c. Regadenoson: 0.4 mg in a 5 ml prefilled syringe. Inject the Regadenoson over 10-15 seconds followed by 5-10 ml of normal saline via flush or IV line. Inject isotope at 10-20 seconds after saline flush.
2. When possible, perform a low-level treadmill test in conjunction with Regadenoson injection for patients who can tolerate walking slowly. DO NOT walk patients who have left bundle branch block, pacemakers, abdominal/thoracic aneurysms, recent MI within the last 3 days, or patients with physical limitations if the purpose is to evaluate for ischemia.
- a. Walk patient on the treadmill slowly in warm-up at 0% incline.
  - b. Inject Regadenoson followed by isotope once the exercise stage begins at 1.7 mph and 0% incline. Adjust speed if needed for patient's comfort and safety.
  - c. Have patient walk for 4 minutes and enter recovery stage.

**D. Reversing:**

1. Aminophylline 1mg/kg IV is used to reverse the effects of A2a agonists.
  - Aminophylline 25-75 mg (in increments of 25 mg) can be given by slow intravenous injection over 30–60 seconds to attenuate severe and/or persistent side effects lasting >3-5 minutes.
  - May repeat Aminophylline 25-75 mg once more to a maximum dose of 150 mg.
  - Continuously monitor patient status (ECG, vitals, symptoms) during medication administration and post-infusion until close to baseline.
2. Stress agent will be terminated or reversed at any time for the following:
  - Wheezing or respiratory distress
  - Severe hypotension (SBP <80 mm Hg)
  - Development of second degree type II or complete heart block
  - ST elevation or severe chest pain associated with ST depression of 2 mm or greater (unless there were baseline ST abnormalities making the ST segment depression less diagnostic)

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- Technical problems with monitoring equipment or patient's request to stop

**E. Complications or Emergencies:**

1. Bronchoconstriction:

- If patient experiences respiratory distress such as wheezing, apply supplemental O<sub>2</sub> via nasal cannula and give Albuterol MDI 2 puffs. Adjust O<sub>2</sub> nasal cannula and repeat Albuterol 2 puffs to maintain O<sub>2</sub> saturation  $\geq 94\%$ .
- Albuterol nebulizer 2.5mg/3ml (0.083%) can also be given.
- Notify the Attending Physician STAT.

2. Severe Hypotension:

- Reverse with Aminophylline as indicated.
- Place patient flat in bed or Trendelenburg and infuse with 250ml bolus of NS.

3. Ischemia with ST elevation or significant ST depression:

- Reverse with Aminophylline as indicated.
- Give O<sub>2</sub> via nasal cannula and NTG 0.4mg SL or 1-2 sprays if SBP is  $>110$  and ST changes persist.
- Notify the Attending Physician and prepare for possible admission.

4. Advanced Heart Block, Life Threatening Arrhythmias, Cardiopulmonary Arrest:

- Follow the "CODE BLUE" procedure in the nursing policy and procedure manual and implement ACLS protocol.

**F. Post-Procedure:**

1. Once the test is terminated, patient will be disconnected from the monitoring equipment and wait to complete the stress images.
2. PIV will be removed by the Nuclear Medicine tech. All items contaminated by the isotope are placed in the appropriate container and disposed of by the Nuclear Medicine staff.
3. Consultation or Referral:
  - Consult with Attending Physician regarding any unstable patient that does not respond to the appropriate treatment, or at the AHP's discretion.
  - Refer to appropriate health care provider as necessary.
  - Inform the referring provider of test cancellation or changes.

**V. DOCUMENTATION**

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**A. Pre Procedure H+P:**

1. The pre-procedure H+P will be completed by the AHP and documented into the electronic medical record.

**B. Report:**

1. Documentation is in the electronic medical record.
  - The report should include all findings including any abnormal or unexpected events and treatments. The initial report is written by the AHP and reviewed by the Attending Physician.
2. Administered medications are documented in the report and the nurse's MAR.
3. Complications, follow-up, or reasons for cancellations may be written in the progress notes.

**VI. COMPETENCY ASSESSMENT**

**A. Initial Competence:**

1. The Advanced Health Practitioner will be educated on the efficacy and indications of cardiac stress testing and demonstrate knowledge of the following:
  - Medical indication and contraindications of A2a agonists
  - Risks and benefits of the procedure
  - Related anatomy and physiology
  - Consent process
  - Steps in performing the procedure
  - Documentation of the procedure
  - Ability to interpret results and implications in management
2. Each candidate will be initially proctored and signed off by a supervising physician or provider.
3. The Advanced Health Practitioner will observe the supervising physician or provider to perform each procedure 5 times and then perform the pharmacological stress tests **200** times under supervision.
4. The supervising physician or provider will document the Advanced Health Practitioner's competency before the AHP can perform procedures without direct supervision.

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5. The Advanced Health Practitioner will ensure completion of competency on the sign-off documents and provide a copy to keep in their personnel file and a copy to the medical staff office for their credentialing file.

**B. Continued Proficiency:**

1. The Advanced Health Practitioner will demonstrate competence by successful completion of the initial 200 tests.
2. The Advanced Health Practitioner will perform **50** pharmacologic stress tests per year to maintain competency.
3. Demonstration of continued proficiency shall be monitored through the annual evaluation and medical staffing.
4. A log of clinical practice outcomes needs to be submitted with each renewal of credentials. It will include the number of procedures performed per year and any adverse outcomes. If there was an adverse outcome, a copy of the procedure note will be submitted.

**VII. RESPONSIBILITY:**

Questions about this procedure should be directed to the Non-Invasive Cardiology Stress Department and Nuclear Radiology.

**VIII. HISTORY OF POLICY**

Revised February 2012 by Subcommittee of the Committee for Interdisciplinary Practice

Reviewed February 2012 by the Committee on Interdisciplinary Practice

Previous revisions May 2009

Approved February 2012 by the Executive Medical Board and the Governance Advisory Council.

Revised and Approved March 2016 by the Committee on Interdisciplinary Practice, Executive Medical Board and Governing Body.

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**REFERENCES**

ASNC Imaging Guidelines for Nuclear Cardiology Procedures: Stress protocols and tracers (2009). Available at <http://www.asnc.org> codes or guidelines that are directly relevant to the policy.

Gibbons RJ, et al. ACC/AHA 2002 guideline update for exercise testing: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Exercise Testing). 2002. American College of Cardiology Web site. Available at: [www.acc.org](http://www.acc.org).

Klocke FJ, et al. ACC/AHA/ASNC guidelines for the clinical use of cardiac radionuclide imaging: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/ASNC Committee to Revise the 1995 Guidelines for the Clinical Use of Radionuclide Imaging). (2003). Available at: <http://www.asnc.org>.

Myers, J., et al. AHA Scientific Statement: Supervision of Exercise Testing by Nonphysicians. *Circulation*. 2014; 130:1014-1027.

**ADDENDUM:**

**STRESS ONLY/ONE DAY STRESS/REST:**

According to the ASNC imaging guidelines for SPECT nuclear cardiology procedures: Stress, protocols, and tracers (Journal of Nuclear Cardiology, Henzlova et al 2016), for many patients, 2-day imaging is impractical, and thus stress and rest studies are usually performed using a 1-day protocol. This requires administration of a lower dose for the first injection and a higher dose for the second injection.

In patients without a high pre-test probability of a stress perfusion defect or left ventricular dysfunction or dilatation (no previous MI, CABG, coronary intervention, low EF, LBBB, previous OHT, BMI>35), a low-dose stress/high-dose rest Tc-99m protocol is advantageous because a significant percentage of these patients will have normal stress imaging, thereby



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enabling obviating the need for the rest imaging with its additional radiation exposure, and permitting performance of stress-only imaging.

Henzlova, M, et al. (Feb 2016) ASNC Imaging Guidelines for SPECT nuclear cardiology procedures: Stress, protocols, and tracers. Journal of Nuclear Cardiology